

Application No. 09/002,007
Attorney's Docket No. 015290-238

REMARKS

Further to an interview with Examiner Vinh and Supervisory Primary Examiner Utech on December 18, 2001, the substance of which is incorporated in the following remarks, reconsideration of the August 24, 2001 Official Action is respectfully requested.

The only issues raised in the Official Action are (1) the rejection of Claims 1-4, 6-12 and 16-22 under 35 U.S.C. §103(a) as allegedly being unpatentable over U.S. Patent No. 5,980,768 ("Abraham") in view of U.S. Patent No. 5,919,599 ("Meador") and (2) the rejection of Claims 5 and 13 under 35 U.S.C. §103(a) as allegedly being unpatentable over Abraham in view of Meador and further in view of the Examiner's position that "the selection of particular flow rates would simply involve routine experimentation" (see paragraphs 3 and 4, on pages 3-5 of the Official Action). These rejections are respectfully traversed.

Independent Claim 1 sets forth a process for removing exposed areas of an organic ARC on a metallic layer, the exposed areas of the ARC having been exposed by previously etching a photoresist covering the ARC, the process comprising exposing the exposed areas of the ARC to an oxygen-free system of etching agents in an ionized state in a reaction chamber of a plasma generating device, the system of etching agents being nitrogen-free and including one or more fluorine-containing compounds, chlorine and an optional inert carrier gas. Claims 2, 3, 4, 5, 6, 7, 8, 9, 10, 16 and 18 depend from Claim 1.

Claim 2 sets forth that the one or more fluorine-containing compounds is selected from the group consisting of CF_4 , CHF_3 , C_2F_6 , CH_2F_2 , SF_6 , and C_nF_{n+4} . Claim 3 sets forth

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that the ARC is exposed by channels forming a circuit pattern previously etched in the photoresist covering the ARC. Claim 4 sets forth that the system of etching agents consists essentially of CHF_3 , Ar, and Cl_2 . Claim 5 sets forth that the process is carried out within the following window: Pressure — about 1 to about 100 millitorr; Temperature — about 30° to about 80°C ; Cl_2 flow — about 5 to about 60 sccm; Ar flow — about 5 to about 80 sccm; CHF_3 flow — about 5 to about 80 sccm. Claim 6 sets forth that the ARC on the metallic layer has been used to prevent actinic light passing completely through the photoresist from being reflected from the metallic layer back through the photoresist during the exposure process. Claim 7 sets forth that the plasma generating device is evacuated to a pressure below 100 mTorr while etching the ARC with the etching agents. Claim 8 sets forth that the plasma generating device comprises an ECR reactor and the ARC is on a semiconductor substrate. Claim 9 sets forth that the ARC is on a semiconductor wafer and Claim 10 sets forth that the plasma is generated adjacent a substrate including the ARC, the plasma generating device including a dielectric window facing the substrate and an antenna outside the reaction chamber, the antenna forming the plasma by inductively coupling radio frequency energy through the dielectric window and into the reaction chamber. Claim 16 sets forth that the organic ARC consists essentially of polyimide. Claim 18 sets forth that the plasma generating device is evacuated to a pressure below 40 mTorr while etching the ARC with the etching agents.

Independent Claim 11 sets forth a method for substantially preserving a photoresist while removing exposed areas of an organic ARC during the manufacturing of an integrated

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circuit, comprising exposing the ARC to an oxygen-free system of etching agents in an ionized state in a reaction chamber of a plasma generating device, the system of etching agents being nitrogen-free and including one or more fluorine-containing compounds, an inert carrier gas and chlorine. Claims 12, 13, 19 and 21 depend from Claim 11.

Claim 12 sets forth that the one or more fluorine-containing compounds is trifluoromethane and the inert carrier gas is argon. Claim 13 sets forth that the process is carried out within the following window: Pressure — about 1 to about 100 millitorr; Temperature — about 30° to about 80° C; Cl_2 flow — about 5 to about 60 sccm; Ar flow — about 5 to about 80 sccm; CHF_3 flow — about 5 to about 80 sccm. Claim 19 sets forth that the organic ARC consists essentially of polyimide. Claim 21 sets forth that the plasma generating device is evacuated to a pressure below 40 mTorr while etching the ARC with the etching agents.

Claim 22 sets forth a process for etching a pattern of exposed areas of an organic ARC, comprising exposing the ARC to an oxygen-free system of etching agents in an ionized state in a reaction chamber of a plasma generating device, the system of etching agents being nitrogen-free and including one or more fluorine-containing compounds, chlorine, and an inert carrier gas, wherein a photoresist layer forming the pattern of exposed area is disposed on the organic ARC, and wherein the organic ARC is selectively etched and the photoresist is substantially preserved such that lateral degradation of the photoresist layer forming the pattern of exposed areas is substantially prevented.



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In the Official Action, Abraham is cited for a disclosure of using an oxidant-free N₂ containing etching gas to break through an organic ARC (Official Action at page 2) and Meador is cited for a disclosure of etching an organic layer "using various gases or gases mixture such as oxygen, chlorine, CF₄, CHF₃, SF₆, their admixture with nitrogen, Ar and He" (Official Action at page 3). The Official Action alleges that it would have been "obvious to modify Abraham by etching Abraham's organic ARC using a gas mixture as taught by Meador" (Official Action at page 3). As explained below, however, the combination of Abraham and Meador fails to suggest the claimed process.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). Additionally, a prior art reference must be considered in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention. *W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983), cert. denied, 469 U.S. 851 (1984). See MPEP 2141.02.

Claim 1 has been amended to include the nitrogen-free feature of Claim 17. In the

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present case, neither Abraham nor Meador suggests the process recited in Claim 1 of etching an organic ARC with an oxygen-free and nitrogen-free system of etching agents including one or more fluorine-containing compounds, chlorine and an optional inert gas. Instead, Abraham discloses "breaking through an organic-based antireflective coating [using] an etchant source gas consisting essentially of nitrogen" (column 4, lines 16-25 of Abraham). Abraham states that "the inventive N₂ etching process is employed as the etching step for the organic-based ARC layer . . . prior to performing the main etching step" (column 5, lines 27-30 of Abraham) and that the "etchant source gas is substantially oxidant-free" (column 7, lines 33-35 of Abraham). In the only example of Abraham, the etch gas is pure N₂ supplied at a flow rate of 60 sccm (column 8, lines 29-62 of Abraham). Meador, on the other hand, lists several gases in column 8 thereof but only provides two examples of suitable organic ARC etch gas chemistries, i.e., oxygen (column 11, lines 62-64 and column 12, lines 64-65 of Meador) or argon, CF₄, CHF₃ and He (column 12, lines 65-66 and column 13, lines 25-26 of Meador). Although the argon, CF₄, CHF₃ and He etch gas of Meador is oxygen-free, it does not include chlorine or nitrogen. In view of Abraham's teaching to use N₂ it is submitted that the Official Action does not provide the requisite incentive/motivation for modifying Abraham to use the argon, CF₄, CHF₃ and He etch gas of Meador. However, even if one were to go against the teachings of Abraham

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and use the argon, CF₄, CHF₃ and He etch gas of Meador, the resulting combination still fails to produce the process recited in Claim 1.

Claim 11 has been amended to include the subject matter of Claim 20, i.e., that the claimed process is carried out using a nitrogen-free system of etching agents. As explained above, it would be necessary to go against the teachings of Abraham to use an etch gas which is free of nitrogen. As set forth in MPEP § 2143.01, the proposed modification cannot change the principle of operation of a reference and as set forth in MPEP § 2141.02, the prior art must be considered in its entirety, including teachings away from the claimed invention. In the present case, Abraham teaches away from using a nitrogen-free system of etching agents and the proposed modification of Abraham would impermissibly change the principle of operation of Abraham's etch process. Accordingly, Claim 11 and claims dependent thereon are clearly patentable over the cited references.

Claim 4 recites that the system of etching agents consists essentially of CHF₃, Ar and Cl₂, a combination of gases not suggested by Abraham or Meador. Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention *where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art.* *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988); *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). The mere fact that references



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can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990). See MPEP 2143.01. Further, a statement that modifications of the prior art to meet the claimed invention would have been "well within the ordinary skill of the art at the time the claimed invention was made" because the references relied upon allegedly teach that all aspects of the claimed invention were individually known in the art is not sufficient to establish a *prima facie* case of obviousness without some objective reason to combine the teachings of the references. *Ex parte Levengood*, 28 USPQ2d 1300 (Bd. Pat. App. & Inter. 1993). See also *At-Site Corp. v. VSI Int'l Inc.*, 174 F.3d 1308, 50 USPQ2d 1161 (Fed. Cir. 1999) (The level of skill in the art cannot be relied upon to provide the suggestion to combine references). In the present case, the cited references do not provide any hint that a system of etching agents consisting essentially of CHF_3 , Ar and Cl_2 would be useful in etching an organic ARC layer. As such, it is respectfully submitted the process recited in Claim 4 is clearly patentable over the cited references.

Applicants submit that the differences between the claimed subject matter and the prior art are such that the claimed subject matter, as a whole, would not have been obvious at the time the invention was made to a person having ordinary skill in the art.

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In view of the foregoing, Applicants submit that the present application is in
condition for allowance and such action is earnestly solicited.

Respectfully submitted,

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